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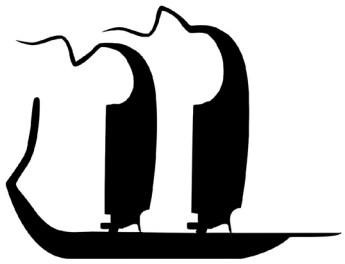

Association Affairs

PACIFIC SCIENCE ASSOCIATION

PSA Activities

Climate Change and Biodiversity in Melanesia (CCBM) Project Report

Bishop Museum, Pacific Regional Environment Programme (SPREP) along with the Pacific Science Association (PSA) and Indo-Pacific Conservation Alliance (IPCA), have announced initial findings in their MacArthur Foundation-funded study, ***Climate Change and Biodiversity in Melanesia*** (CCBM). These findings were announced at the 8th Pacific Islands Conference on Nature Conservation and Protected Areas held in Alotau, Milne Bay province in Papua New Guinea in October 2007.

The global warming project was launched in September 2007 with a workshop of experts, which included climate change and biodiversity scientists specializing in the Melanesian region. Dr. Allen Allison, Dr. Stephen Leisz (Geospatial Scientist at Bishop Museum), and John Burke Burnett (Executive Secretary of PSA) hosted the meetings to assess the best "State of the Science" regarding projected impact of climate change on biodiversity in Melanesia. Melanesia (Papua New Guinea and Indonesia's Papua Province, Solomon Islands, Vanuatu, New Caledonia, and Fiji) is one of the world's highest biodiversity areas with many endemic species and the planet's richest coral reefs. Being largely a region dependent on agriculture, fisheries and other natural resources, the attendant socio-economic and health implications of climate change on Melanesia's ecosystems are potentially grave. The importance of preserving Melanesia's rich biodiversity should thus be considered in terms of human societies' dependence on ecosystem services it provides.

A key point highlighted by the workshop participants is that projections by the world's preeminent body on climate science, the U.N. Inter-Governmental Panel on Climate Change (IPCC), lack precision on specifically how climate change will affect Melanesia. Computer climate models do not yet have a sufficiently fine-scale resolution to "see" islands. An additional complication is the inherent uncertainty of different possible future global carbon emissions scenarios. Because of these uncertainties, the CCBM study is important to determine how projected broad-scale climate pattern changes will specifically impact the Melanesia region. So while many ambiguities remain, several consistent patterns have begun to emerge.

Warming and El Niño

It is likely that warming in the western tropical Pacific will closely follow the projected global average warming rate of 1.8° to 4.0° C (3.2° to 7.2° F) by the year 2099. El Niño/La Niña

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cycles (known as ENSO) are known to have major effects on the climate of Melanesia. Dr. Axel Timmermann of the International Pacific Research Center (IPRC) at the University of Hawaii at Manoa said that the often-repeated statement that global warming in the Pacific will result in "more persistent El Niño-like conditions" is somewhat misleading. El Niño refers to a specific kind of cyclic state that may or may not resemble future climate patterns under warming scenarios. In Melanesia, El Niño generally results in hotter and drier land conditions, but paradoxically—relatively cool sea temperatures. Conversely, La Niña conditions in Melanesia mean relatively wet conditions on land—which implies cloudiness that tends to suppress temperatures—but far hotter sea surface temperatures. This results in more frequent and intense coral bleaching.

Large-scale changes in ocean circulation patterns in the Pacific are thought to be another highly plausible result of global warming, but it is not yet possible to accurately predict exactly how, where, and what these circulation changes may be. Increased temperature, changes in rain fall, wind speed and direction, sea level rise, and increased intensity of tropical cyclones are likely scenarios for Melanesia, but since regional climates in the Pacific region are strongly affected by ENSO and ocean circulation—factors that heavily influence such events—it is not yet possible to estimate with precision to what degree these changes will happen, or how they vary from one island to another in the western tropical Pacific.

SSTs and Coral Bleaching

Sea surface temperatures (SSTs) are warming fastest near the equator and less quickly towards the higher latitudes (both north and south of the equator). So while all of Melanesia's reefs and oceans will become warmer, resulting in an increase in coral bleaching events, northern Melanesia is likely to experience more frequent and prolonged coral bleaching events before southern areas of the region. However, Dr. Steve Coles of the Bishop Museum noted that reef ecosystems and species may have more resilience to such bleaching than previously thought. Recent scientific studies suggest that many corals are less susceptible to coral bleaching than had been previously thought. The study concludes that with careful design and management of marine protected areas (MPAs), and through the use of other conservation measures, coral reef ecosystems may exhibit a degree of resilience in the face of increased sea surface temperatures.

Sea-Level Rise

Dr. Axel Timmerman suggests that sea-levels in the northern Melanesia area have been rising faster than the global mean sea-level rise, and indications are that they will continue to rise faster than the global average, currently projected by the IPCC to be around one-half to one meter by 2100. Looking at sea-level rise in isolation from other factors such as bleaching and acidification, and coastal flooding, coral reef accretion can probably keep pace with rising seas. Melanesia also has some of the world's largest remaining stands of coastal mangrove habitat, which is highly subject to sea-level rise impacts. However, Dr. Geoff Hope from the Australian National University noted in the workshop that mangroves have the capacity to adapt to sea-level rise by (a) trapping sediment and thereby raising their base level, and (b) by migrating (through reproduction) in-land as sea-levels rise. Defensive structures such as seawalls or roads, if appropriately sited, could limit coastal resilience by preventing mangroves from migrating inland as sea-level rises. Atolls and some other coastal areas will be particularly hard-hit by sea-level rise, but projections are not necessarily straight-forward. Dr. Hope concluded that mangrove forests such as those in southwestern New Guinea may protect some low-lying areas from complete inundation by capturing and redistributing sediment.

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Ocean Acidification

Oceans naturally absorb CO_2, but the scale of recent human-produced carbon emissions is so large that it is changing the chemistry of the Earth's oceans. Carbonic acid forms when oceans absorb CO_2, and global ocean surface waters have become more acidic in recent decades, resulting in a drop of 0.1 pH. (The pH scale is a measure of acidity and alkalinity ranging from 0 to 14, with 7 being neutral: A 0.1 unit decrease means that acidity has increased by 30%.) Depending on the path of future global carbon emissions, ocean surface pH could decrease by an additional 0.3 to 0.7 pH units by 2100. Such changes have not occurred on the planet for hundreds of thousands or possibly tens of millions of years, and never on such a rapid timeframe.

Acidification of ocean waters reduces the availability of calcium carbonate required by organisms such as corals, sea urchins, clams, and zooplankton. Acidification also interferes with respiratory processes in fishes, and may also negatively impact their food supply. John Burke Burnett notes that "the most recent scientific projections are that calcium carbonate levels in the world's equatorial regions will become marginal by 2070, and even sooner in the higher latitudes." This will result in the slowing or even reversal of reef formation and shell formation, possibly resulting in major disruptions to marine food webs. It appears likely that ocean acidification will result in fundamental changes in marine community structures in both coastal and pelagic area. It is likely that this will result in very serious negative impacts on both near-shore and deep water fisheries, ecosystem services such as provision of food sources, and storm protection provided by coral reefs.

Climate Change and Terrestrial Biodiversity

Melanesian terrestrial animal and plant species are especially vulnerable to climate change because of high levels of endemicity in the region. Melanesian terrestrial animal species that are most threatened by climate change are those found near the tree line at higher elevations; those found in isolated or outlying mountain ranges; small island mammals; and larger mammals. It is possible that species could shift their ranges along both latitudinal and elevational gradients, but this depends on other factors that are highly uncertain, such as cloud formation and conditions as well as a myriad of other complex ecological interactions such as changes in inter-species competition and predation, seeding and fruiting patterns, etc., not to mention land-use changes.

Dr. Geoff Hope pointed out that species and ecosystems have adapted to past climate changes. However, he underscored that during those past periods of climate change the ecosystems most at risk were healthier than they currently are. In today's world, most ecosystems are already under pressure from other human-based threats (e.g. over-hunting, overfishing, land cover changes due to human activities, etc.). The effects of climate change add yet one more stress factor to these ecosystems, and in some cases may become the "straw that breaks the camel's back".

Adapting to Climate Change

Regardless of future carbon emission scenarios, climate change is already with us, according to the latest IPCC report. So, while it is critical to reduce greenhouse gas emissions, it is equally important for island communities to take steps to mitigate the projected impacts of global warming on their livelihoods, economies, and biodiversity. Islands and marine ecosystems are already under particular pressure from a range of threats including over-harvesting of natural resources, loss of habitat, and marine pollution.

The workshop participants agreed that establishing effective networks of marine protected

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areas is one of the critical tools that can assist in protecting both vulnerable habitats as well as critical ecosystem processes, and thereby enhance resilience to climate change impacts. Likewise, preserving terrestrial habitat is critical in order to mitigate climate change effects on island ecosystems. For example, protecting intact forest preserves hydrological processes that generate cloud cover, which both reduces temperature and maintains adequate rainfall.

The workshop participants concluded that climate change by itself isn't likely to be the main driver of plant and animal biodiversity losses on land and at sea. Rather, it is climate change in combination with existing stresses, such as habitat loss, overuse of resources, and invasive species that will amplify and accelerate these losses. While the Earth's climate system is committed to some degree of climate change because of increased anthropogenic CO_2, and that early and deep reductions in future carbon emissions are critical, much can still be done to increase resilience of biota to adapt to climate change is enhanced. "One of the key messages from the Bishop/SPREP vulnerability study is that maintaining healthy ecosystems through good management practices will enhance resilience to future climate impacts," says Dominique Benzaken from SPREP.

The workshop participants also agreed that there is currently a significant dearth of several kinds of data for Melanesia that are important to understand climate change and how to adapt to it. Such data gaps include information on baseline rainfall, temperatures, biogeographical patterns, species physiology and ecological requirements of most marine and terrestrial species. This information is important in order to build better climate models that will allow more accurate regional projections and forecast potential impacts on biota and ecosystem services. The workshop further identified two additional priorities: the need to strengthen in-country capacity of local scientists to conduct research, and for scientists from outside Melanesia to return information to local stakeholders so that they can better understand climate change-related factors and how best to respond and adapt.

Background on the CCBM Study

In February 2007, Bishop Museum was awarded a $290,000 grant by the John D. and Catherine T. MacArthur Foundation to be used over eighteen months to study climate change planning and mitigation to help stem the threats of global warming. Bishop Museum was one of eight institutions worldwide to receive part of the Foundation's $5 million investment in studying how species and habitats are impacted as a result of climate change and ocean acidification, both the result of rising global carbon dioxide levels.

All the information from the CCBM study is being organized in and made available on the Internet at http://www2.bishopmuseum.org/ccbm/. This information can be used in conjunction with other analytical tools to form the core of an environmental information system for Melanesia climate change. Such tools are critical to government agencies and nonprofit organizations involved in environmental, conservation, and development planning.

The three major components of the study are: To access the current scientific understanding of the impacts of climate change and other biogeochemical processes on island and marine ecosystems in Melanesia; to document the institutional and socioeconomic adaptive capacity of Melanesian countries to effectively respond to climate change impacts including legislation, policies and capacity assessment; and to develop an integrated assessment of the vulnerability of Melanesia's biodiversity to climate change.

The Melanesia study includes the islands of Fiji, Vanuatu, New Caledonia, Solomon Islands, Papua New Guinea, and the Indonesian Province of Papua. The results and products of CCBM will provide conservationists and resource managers in Melanesia with information and tools they need to develop responses to anticipate and plan for protected climate change impacts on biodiversity and island communities. According to Dr. Allison, "Efforts like CCBM are an essential step in ensuring that conservation efforts succeed in tomorrow's climate."

Partners in the research include the Pacific Regional Environmental Programme (SPREP)

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based in Apia, Samoa; and the Pacific Science Association (PSA) and Indo-Pacific Conservation Alliance (IPCA) both based at Bishop Museum. IPCA works in partnership with local communities in New Guinea on field-based conservation projects that maintain biodiversity as "living landscapes" that continue to provide livelihoods to communities while maintaining their unique biodiversity.

Climate change impacts have been a major concern of Pacific Island countries since the 1990s. In response to those concerns, the Pacific Island Forum leaders endorsed the Pacific Islands Framework for Action on Climate Change (PIFACC) in 2006. The PIFACC identified six focal areas for action, including improving understanding of climate change and implementing adaptation measures. The CCBM study not only meets the objectives of the PIFACC, but also informs and complements a major GEF proposal on Pacific Adaptation to Climate Change (PACC) to be implemented by SPREP in eleven Pacific Island Countries. PACC will focus on priority sectors such as food production, water resource management, and coastal management. Additional information on PIFACC and related climate change projects can be found on the SPREP website, http://www.sprep.org.

Announcements

I. PSA Executive Board Meeting

A PSA Executive Board Meeting was held in January 2008 in Kuala Lumpur, Malaysia. This was the first official convening of the new PSA Board following their election at the 21st Pacific Science Congress in Okinawa in June 2007.

As noted above, a new PSA Executive Board was elected by the Pacific Science Council at the 21st Pacific Science Congress. The full list and institutional affiliations of the new PSA Board are:

- PSA President: Dr. Congbin Fu, Institute of Atmospheric Physics, Chinese Academy of Sciences (China-Beijing)
- PSA Vice-President: Dr. Nancy Lewis, Director, Research Program, East-West Center (USA)
- PSA Secretary-General: Dr. Makoto Tsuchiya, Dean of the Faculty of Science, University of the Ryukyus (Okinawa)
- PSA Treasurer: Dr. Azizan Abu Samah, Dept. of Geography, University of Malaya (Malaysia)
- Past-President: Prof. Kiyoshi Kurokawa, Science Advisor to the Prime Minister (Japan)
- Ordinary Member: Prof. Chang-Hung Chou, Director, Research Center for Biodiversity, China Medical University (China-Taipei)
- Ordinary Member: Dr. Mazlan Othman, Director General, National Space Agency, Malaysia (Malaysia)
- Ordinary Member: Academician Valentin Sergienko, Chairman, Russian Academy of Sciences – Far Eastern Branch (Russia)
- Ordinary Member: Dr. Ana Taufe'ulungaki, Pro Vice Chancellor, Research and Graduate Affairs, University of the South Pacific (Pacific Islands)

II. Website for the 11th Pacific Science Inter-Congress: Tahiti, March 2009

The website for the 11th Pacific Science Inter-Congress is now online at http://www.psi2009.pf. The Inter-Congress will be held at the Sheraton Hotel in Tahiti, French Polynesia from 2 to 6 March 2009. The deadline for submission of abstracts is October 2008 (exact dates TBD). Early Bird registration closes on 30 November 2008.

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The theme of the 11th Inter-Congress is "Pacific Countries and their Ocean: Facing Local and Global Changes". The sub-themes of the Inter-Congress are:

- Ecosystems: Biodiversity and Resource Valuation
- Climate Variability: Impacts and Prevention
- Public Health: Threats to Public Health in the Pacific Region
- Culture and Politics: The Cultural and Political Stakes of Modernity
- Economy: Economic Challenges for the Future of the Pacific

Additional planning discussions for the conference were conducted at the January 2008 PSA Executive Board Meeting. Additional details on the Inter-Congress will be posted on the PSA and event websites, or contact secretariat@psi2009.pf for further information.

Membership Application

I/We wish to enroll in the Pacific Science Association in the following membership category:

- ❑ Associate scientific institution (US$50)
- ❑ Corporate associate (US$100)
- ❑ Individual associate (US$40)

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- ❑ Enclosed is a ❑ check ❑ money order in U.S. funds, payable to Pacific Science Association.
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Return to Pacific Science Association, 1525 Bernice St., Honolulu, Hawaii 96817, USA.

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Pacific Science Association Membership Information

The Pacific Science Association is a regional, nongovernmental scientific organization founded in 1920. The objectives of the association are to advance science and technology in the Pacific region by increasing interdisciplinary collaboration; to build capacity in science and technology; to encourage science for public policy and the common good; and to promote the "science of the Pacific" and Pacific Island involvement in regional and international scientific activities. Scientific committees have been long established to study and to seek solutions for important problems of Pacific interest. Scientific task forces have been established to explore interdisciplinary and multidisciplinary areas identified as relevant.

Regular members of the association are adhering organizations (e.g., the national academy of science or a like body) from each country or definite geographic area within or bordering the Pacific Ocean, or with scientific interests in the region. In addition, associate membership may be held by individual scientists, scientific societies and institutions, and corporations.

The association is directed by the Pacific Science Council with its elected executive board. The executive board meets annually and makes recommendations to the council, which meets during congresses and inter-congresses. The president serves as chair of the council. The secretariat is located at:

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